

25. (New) A bell having a plurality of modal frequencies, the bell having a bell structure including a top portion, a side portion and a mouth, the side portion extending from the top portion to the mouth, and physical characteristics of the bell structure being selected from the group consisting of conicity of the top portion, wall thickness of the top portion, length of the side portion, conicity of the side portion, wall taper of the side portion, wall curvature of the side portion, and wall thickness of the side portion, such as to provide means for producing a first three frequencies of the plurality of modal frequencies substantially in an harmonic sequence.

REMARKS

Applicant's attorney wishes to thank the Examiner for the careful consideration given this case. This response addresses those issues raised in the Office Action mailed August 22, 2002. Applicant acknowledges the Examiner's comments made during a teleconference on January 6, 2003, regarding the earlier finding that Claims 22, 23 are likely allowable as previously amended upon overcoming the rejection under 35 U.S.C. § 101. Applicant also acknowledges the Examiner's guidance given during a January 21, 2003, teleconference on the amendments shown above and the following remarks.

Objections to Claims 12 and 20

The Examiner has objected to claim 12 stating that there was insufficient antecedent basis for "the side portion" in line 1. A similar objection was made to claim 20 for the limitation of "an initial bell shape." Claims 12 and 20 have been amended and now provide proper antecedent basis for these elements. In view of these amendments, Applicant believes these claims are in proper form for allowance.

Rejection of Claims 1-13, 15-21 under 35 USC § 112, second paragraph

Claims 1-13, 15-21 were rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 1, 2, 13 and 15 have been amended to distinctly point out that the “first at least three frequencies” in claims 1, 2 and 15 are the first three frequencies (at minimum) of the plurality of modal frequencies. Similarly the amendment to Claim 13 points out that the “first at least four frequencies,” are distinctly *the* first four frequencies of the plurality of modal frequencies.

Accordingly, Applicant believes that Claims 1, 2, 13 and 15, and all claims depending therefrom, are now in proper form for allowance. Applicant notes that the above amendments to Claims 1, 2, 13 and 15 were made for purposes of clarity and not were related to patentability of the claimed subject matter. Furthermore, the clarified claim language is expressly understood to literally encompass a bell having a plurality of modal frequencies wherein any number of frequencies equal to or greater than three are substantially in an harmonic sequence.

The Examiner has also objected to the term “substantially” in claims 1, 13, and 15, characterizing it as a relative term which renders the claims indefinite. Applicant respectfully submits that the term “substantially” is not indefinite as used throughout the specification. Applicant’s use of the term “substantially” within the phrase “substantially in an harmonic sequence” does set forth a standard for ascertaining the requisite degree of definiteness.

For example, on page 5, lines 22-26, Applicant sets forth a definition of this phrase as follows:

“In this specification, a reference to the frequencies of the first at least three modes being substantially in an harmonic sequence means that the frequencies of the first at least three modes substantially conform to the ratios 1, 2, 3 etc. (with respect to, and including, the fundamental). A bell wherein the frequencies of the first several modes are substantially in an harmonic sequence is referred to hereafter as “an harmonic bell”. (emphasis added)

Thus, in accordance with Applicant’s definition, an harmonic bell is a bell having frequencies of the first at least three modes substantially conform to the whole integer ratios 1, 2, 3, etc. including the fundamental.

Further, examples of harmonic sequences having these ratios are provided throughout the specification. For example, on page 21, lines 26-27, the text directs attention to Figure 9, and states that this Figure illustrates “five frequencies are now substantially in an harmonic sequence.” Figure 9 depicts seven (7) frequencies and their respective frequency ratios, and further provides the absolute frequencies (in Hertz) for each of these frequencies. By calculating the frequency ratios of the first five frequencies, and using the absolute frequencies provided in Figure 9, you arrive at the following ratios: 1 : 2.023 : 3.011 : 3.979 : 5.005. Further, in this example the largest error between the first five modes described as “substantially in an harmonic sequence” is between the first and second mode and is only 1.17%.

Accordingly, Applicant respectfully submits that one skilled in the art can readily ascertain the scope of Applicants use of the term “substantially” by reference to the explicit disclosure mentioned above, and other such examples throughout the specification, such as p. 22, lines 17-20, Figure 10 and Table 1, on p.

20. Taken together¹ it is respectfully submitted that the specification provides the requisite degree of "definiteness" necessary for one of ordinary skill in the art to be apprised of the scope of the Applicant's invention.

It is respectfully submitted that the rejection of Claims 3-12 and 16-21, based upon their dependence on the previously rejected claims above, is now moot in light of the above amendments and explanation.

Claims 1-13 were rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential structural cooperative relationships of elements, such omissions amounting to a gap between the necessary structural connections, reference MPEP § 2172.01. The Examiner identified the omitted structural cooperative relationships as, the structure that allows a bell to have a plurality of modal frequencies, wherein any number of frequencies are substantially in a harmonic sequence.

The structure that allows a bell to have a plurality modal frequencies is not any single fixed structural element, but rather, as explained in the specification, a combination of interacting structural elements which all contribute to the modal frequency of the bell. For example, as described in the specification, varying conicity (p. 10, lines 13-23) effects the frequency of the bell, and the angle of the side portion effects the frequency ratios (p. 10, lines 23 et. seq.). Further, wall taper (p. 11, lines 4-28), wall curvature (p. 11, line 29; p. 12, line 27), the length of the side portion (p. 12, line 28; p. 13, line 8), and the wall thickness (p. 13, lines 9-22) are all structural features that contribute to a bell in accordance with the

¹ A careful comparison of the data set forth in the sections referenced above demonstrates that the largest error between modes is always less than 5%.

claimed invention having a plurality of modal frequencies wherein any number of the frequencies are substantially in an harmonic sequence.

Applicant is presenting new Claims 24 and 25 as alternate means "to particularly point out and distinctly claim the subject matter which the Applicant regards as his invention." Support for Claims 24 and 25 is found throughout the specification and no new matter has been added. The fee for the addition of these two new independent claims is enclosed.

Rejection of Claims 1-13, 15-21 under 35 USC 101

Claims 1-3 and 15-21 were rejected under 35 U.S.C. 101 because the disclosed invention is inoperative and therefore lacks utility. In making this rejection, the Examiner has pointed to statements found in the prior art, *e.g.* the Collins Encyclopedia of Music, pages 20-21, and the Lehr paper, page 20, "an harmonic bell..." having frequencies in the ratios 1,2,3,...N "...is an impossibility."

As put forth in the specification, prior art bells have always sounded out of tune. As further explained, this was accepted because it was assumed to be unavoidable due to the physical characteristics of bells per se. The inventors have disproved this assumption using their design approach that is fully set out in the specification. Further, a Declaration Pursuant to 37 CFR § 1.132, attesting to the actual manufacturing, testing and use of harmonic bells in accordance with the invention, is included herewith as Exhibit "A". By this Declaration, Applicant demonstrates the existence and utility of the invention, thereby traversing this rejection.

Rejection of Claims 1-13 under 35 USC 102(a)

Claims 1-13 were rejected under 35 U.S.C. 102(a) as being anticipated by Fountain et al. (hereafter "Fountain") in the document "Tuning of Bells by

Numerical Methods of Shape Optimism.” With reference to Claims 1-3, Fountain discloses a bell having the first at least three frequencies in the harmonic sequence frequency ratio of “1.0, 2.0, 2.4” (Table 1) prior to tuning. Fountain alternately attempts to tune bells to odd sequence frequency ratios of “1, 3, 5, 7” (*i.e.* Table 2 showing a target value in Hz of 1000, 3000, 5000 and 7000); ratios of “1, 2, 2.4, 3, 4” (*i.e.* Table 3 showing a target value in Hz of 250, 500, 600, 750 and 1000); or ratios of “1, 2, 2.5, 3, 4” (*i.e.* Table 4 showing a target value in Hz of 250, 500, 625, 750, and 1000). None of these disclosures in Fountain (or in any other prior art reference) disclose a bell having the first at least three frequencies substantially in an harmonic sequence as claimed by Applicant. Furthermore, the clarifying claim language of amended Claim 1 and the above discussion of Applicant’s use of the term “substantially” clearly excludes the odd harmonic sequences of Fountain.

With reference to the Examiner’s comments regarding Claim 13, (*i.e.*, Fountain teaches a bell having the first at least four frequencies substantially in a harmonic sequence), Fountain merely acknowledges that, in cylindrical bells of constant wall thickness, it was found that “the first four natural frequencies are highly coupled.” This reference does not disclose a bell with the first at least four frequencies substantially in a harmonic sequence.

It is respectfully suggested that the above clarifying amendments and remarks serve to properly exclude the bells disclosed in Fountain, thereby traversing this rejection.

Rejection of Claims 1-13, 15 and 19-21 under 35 USC 102(a)

Claims 1-13, 15 and 19-21 were rejected under 35 U.S.C. 102(a) as being anticipated by Schoofs et al. (hereafter “Schoofs”) in the document “Computation of Bell Profiles Using Structural Optimization.”

As explained above, Applicant's use of the term "substantially" cannot be properly construed to encompass the approximate harmonic sequences disclosed by Schoofs. Further, Applicant is entitled to benefit from the ordinary meaning of the word "substantially," which is defined *inter alia* as "in a substantial manner; in substance; essentially." *Webster's Revised Unabridged Dictionary*, © 1996, 1998 *MICRA, Inc.*

With reference to Claims 1-3, Schoofs teaches a bell having the first three frequencies in the ratio of "1, 2, 2.5". In Applicant's defined use of the phrase "substantially in a harmonic sequence", (as discussed above) the bells of Schoofs are not encompassed by the claims. Only bells having frequencies of the first three modes substantially conforming to the whole integer ratio 1, 2, 3, etc. are contemplated. It is well settled that the "[A]pplicant is entitled to claims as broad as the prior art and his disclosure will allow." *In re Rasmussen*, 650 F.2d 1212, 1214 (CCPA 1981). Applicant's use of the term "substantially" is therefore proper to accommodate for the minor variations as shown in the specification. Further, when necessary to provide the inventor with the full benefit of his invention, (as is the case here) the use of the term "substantially" is not indefinite. *See, Verve LLC v. Crane Cams, Inc.*, 65 USPQ2d 1051 (Fed. Cir. 2002). A copy of *Verve* is provided herewith for the convenience of the Examiner as Attachment "B".

With reference to Claim 21, (as well as to Claims 22-23), the product in these "product by process" claims is patentable because the product is not the same as, or obvious from a product of the prior art. No prior art reference teaches or suggests an harmonic bell as claimed by Applicant.

Rejection of Claims 16-18 under 35 USC 103(a)

Claims 16-18 were rejected under 35 U.S.C. 103(a) as being unpatentable over Schoofs in view of Fountain. Because neither Schoofs nor

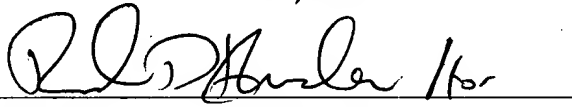
Fountain teach or suggest a "substantially harmonic sequence" of Applicant's invention, as discussed above, Applicant respectfully submits that this rejection is now moot.

In view of the amendments to the claims and the foregoing remarks, it is believed that the present application is in condition for final allowance and notice to such effect is respectfully requested.

If the Examiner believes that additional issues need to be resolved before this application can be passed to issue, the undersigned invites the Examiner to contact him at the telephone number provided below.

Respectfully submitted,

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MARKED UP VERSION OF CLAIMS SHOWING AMENDMENTS MADE

Please amend Claims 1, 2, 12, 13, 15 and 20 as follows:

1. (Twice Amended) A bell having a plurality of modal frequencies, [a first at least three frequencies being] wherein the first three of said frequencies, at minimum, are substantially in an harmonic sequence.

2. (Thrice Amended) A bell as claimed in claim 1, wherein said first [at least] three frequencies[,] are due to modes with no ring nodes.

12. (Twice Amended) A bell according to claim [1] 4 wherein the side portion is generally tapered.

13. (Twice Amended) A bell having a plurality of modal frequencies, [a first at least four frequencies being] wherein the first four of said frequencies, at minimum, are substantially in an harmonic sequence.

15. (Twice Amended) A method for designing a bell shape for a bell having a plurality of model frequencies, [a first at least three frequencies] wherein the first three of said frequencies, at minimum, are substantially in an harmonic sequence, the method comprising the steps of selecting an initial bell shape and using the initial bell shape in an [optimisation] optimization procedure for modifying the bell shape such that said first [at least] three frequencies are substantially in an harmonic sequence.

20. (Twice Amended) A method according to claim 15 wherein the [optimisation] optimization procedure comprises the steps of:

- (a) setting the current bell shape to [an] the selected initial bell shape;

- (b) selecting one of the [at least] first three frequencies to be tuned as a current objective;
- (c) selecting a desired value for the current objective to attain or a desired range for the current objective to fall within;
- (d) modifying the current bell shape in accordance with an [optimisation] optimization method, the [optimisation] optimization method being to cause the value of the current objective to move towards the desired value or range;
- (e) repeating step (d) as many times as necessary for the value of the current objective to become substantially equal to the desired value or for the objective to fall within the desired range;
- (f) if the at least first three frequencies to be tuned are not substantially in an harmonic sequence, selecting one of the at least three frequencies to be tuned as the current objective;
- (g) repeating steps (c) to (e) in relation to the current objective, subject to a suitably chosen constraint or constraints to cause at least one of the frequencies to be tuned to approach or attain a desired value or desired frequency ratio; and
- (h) repeating steps (f) and (g) until the at least first [at least] three frequencies are substantially in an harmonic sequence.